# PATENT SPECIFICATION

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DRAWINGS ATTACHED

**1,085,064**

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COMPLETE SPECIFICATION

## Apparatus for producing Mechanical Shocks

We, PLESSEY-UK LIMITED, a British Company of 56 Vicarage Lane, Ilford, Essex, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to apparatus for producing mechanical shocks of predetermined waveform, primarily for component and equipment testing purposes. More specifically, the invention relates to such mechanical shock-producing apparatus of the kind comprising an equipment mounting platform including an impactor which is arranged to drop under gravity so that consequent upon the impactor striking a bed structure a mechanical shock wave is transmitted through the platform to the equipment under test. The waveform of the mechanical shock wave may be displayed electrically by connecting an oscilloscope to the output of a piezo-electric accelerometer secured to the platform surface carrying the equipment under test. The waveform of the shock wave can be predetermined by suitably shaping the impactor and by the use of appropriate material for the bed structure surface.

According to the present invention, the equipment mounting table or platform of the mechanical shock-producing apparatus essentially comprises fibrous and/or laminated material capable of damping vibrations interposed between the equipment mounting surface and the impactor of the apparatus.

By the use of fibrous and/or laminated material in the equipment mounting platform, the configuration of the mechanical shock wave applied to the equipment under test upon impact of the impactor with the bed structure is considerably improved by the absence or at least the presence on a reduced scale of unwanted secondary vibrations due to resonance of the platform structure. The present invention thus leads to a cleaner shock waveform.

In carrying out the invention it is especially contemplated that a substantial part of the platform will be composed of resin bonded laminate (e.g. cloth or paper laminate) but the use of wood and other materials of a fibrous nature is also envisaged. The performance as regards shock waveform may be improved still further by introducing a layer of resilient material, such as neoprene, between the impactor and the equipment mounting surface of the platform.

The waveform of the shock wave can be predetermined by the shaping of the impactor nose and the nature of the bed structure surface with which the impactor makes contact. For example, a square waveform mechanical shock may be produced by providing the impactor with a suitably angled cone-shaped nose and by employing honeycombed aluminium as the bed structure. A half sinusoidal waveform on the other hand may be had by providing the impactor with a spherical nose and using a rubber bed structure surface.

In one embodiment of the present invention, apparatus for producing mechanical shocks for equipment testing purposes comprises an equipment mounting platform which includes a relatively thick large block of phenol formaldehyde resin-bonded cloth to which an accelerometer embodying a piezo-electric element is mechanically coupled by threading it into a tapped hole in the top surface of the block. The block has P.T.F.E. lined bushes extending through it for slidingly engaging two vertical runners or guides for the platform To the underside of the block is secured a relatively small block of the same material to which a metal impactor is secured, as by bolts, and which is mechanically coupled to the relatively large block through a relatively thin layer of neoprene. The impactor has a nose position which is shaped (e.g. cone shaped or spherical) according to the shape of the mechanical shock to be applied to equipment carried by the platform. The platform is ar-

ranged to be released from any desired height so that it drops under gravity with the impactor making impact with a suitable bed surface medium on the top surface of a heavy bed structure to which the platform vertical guides are rigidly secured.

The output from the accelerometer which will be dependent upon deceleration may be coupled to a cathode follower circuit which in turn is connected to the input of an oscilloscope for displaying the waveform of the shock applied to the equipment.

For the purpose of ensuring that the trace of the mechanical shock waveform appears substantially centrally on the screen of the scope the time base of the scope may be co-ordinated with the fall of the platform and to this end switching means (e.g. photoelectric, electro-mechanical magnetic or electro-magnetic switching means) may be incorporated in the apparatus so that the platform as it reaches a certain point in its drop operates the switching means which in turn triggers the time base of the oscilloscope.

In addition, the apparatus may conveniently include means (e.g. electromagnetically operated) effective for clamping and releasing the platform at any desired height above the bed structure.

One especially contemplated embodiment of the present invention will now be described by way of example with reference to the accompanying drawings in which

Figure 1 is a side elevational view of the shock apparatus;

Figure 2 is a perspective view of the equipment-carrying platform of the apparatus of Figure 1; and,

Figure 3 is a side view of the impactor.

Referring to the drawings the shock apparatus comprises a platform structure 1 of generally frusto-pyramidal shape which is made up of upper and lower blocks 2 and 3 and webs 4 of phenol formaldehyde resin-bonded cloth. The lower block 3 and a still lower block 5 of the same material have a layer of nylon rubber 6 sandwiched between them. Secured to the underside of the block 5 as by screws (not shown) is an impactor 7 of aluminium. As can best be seen in Figure 3, the impactor 7 has a conical nose portion 8 having different angled parts 9 and 10 the purpose of which will be described later.

Referring specifically to Figure 1 it can be seen that the impactor is in vertical alignment with a block 11 of aluminium honeycomb which is supported on a rigid bed 12.

The platform 1 has an upper surface 13 which will in use have secured to it the equipment or component such as shown at 14 to be tested. Also secured to the surface 13 is an accelerometer 15 which will provide an output when the impactor 7 strikes the honeycomb block 11 which output is fed to an oscilloscope to afford an indication of the waveform of the shock wave transmitted to the component.

For the purpose of raising the platform structure 1 a predetermined height above the block 11 and for releasing the structure 1 so that it falls under gravity, the platform structure is guided by rails 16 which pass through bushed openings 17 in the structure 1. The lifting force is applied from an electric motor (not shown) through a cable 18 secured to a grab linkage indicated generally at 19. In order to release the platform structure 1 from the grab it will be arranged that the centre member 20 will be depressed by a trigger arm (not shown) at the requisite height. By so doing the claws 21 are caused to swing outwards away from the platform which is accordingly released.

When the impactor 7 strikes the block 11 the cone-shaped nose 8, as it compresses part of the honeycomb structure sets up a mechanical shock wave in the platform structure 1. The platform structure 1 being composed of phenol formaldehyde resin-bonded cloth which effectively prevents or substantially restrains the setting up of unwanted secondary vibration in the platform structure. The layer 6 of Neoprene also helps in this direction by reducing the amplitude of impact transients. As a result the mechanical shock wave applied to the equipment or component under test will be a clean one.

As has heretofor been mentioned the shape of the impactor nose can be varied to produce different shock waveforms. In the present example using a cone-shaped nose a square shock waveform will be produced. The angle 9 may be varied according to the required rise time of the shock wave. A sharp cutting edge is provided at the commencement of the major diameter portion 22 thereby ensuring that the material of the block 11 is sheared to minimise drag as the material is compressed by the impactor. The other angle 10 providing relief adjacent to the cutting edge just above referred to serves to prevent acceleration overshoot on impact which would otherwise set-up undesirable vibrations.

WHAT WE CLAIM IS:—

1. Mechanical shock producing apparatus of the kind herein before defined in which the equipment mounting platform comprises fibrous and/or laminated material capable of damping vibrations and interposed between the equipment mounting surface and the impactor.

2. Mechanical shock producing apparatus as claimed in claim 1, in which a substantial part of the platform is composed of resin bonded laminate.

3. Mechanical shock producing apparatus as claimed in any preceding claim, in which the platform includes a layer of resilient material between the impactor and the equipment mounting surface.

4. Mechanical shock producing apparatus

as claimed in claim 1 in which the platform is generally frusto pyramidal configuration being made up of relatively large and small upper and lower blocks of resin-bonded laminate which are joined by vertical webs of the same material.

5. Mechanical shock producing apparatus as claimed in claim 4, in which a layer of resilient material is introduced between the lower block and a still lower block of resin bonded laminate to which the impactor is secured.

6. Mechanical shock apparatus and equipment mounting platforms therefor substantially as hereinbefore described and/or illustrated in the accompanying drawings.

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For the Applicants.

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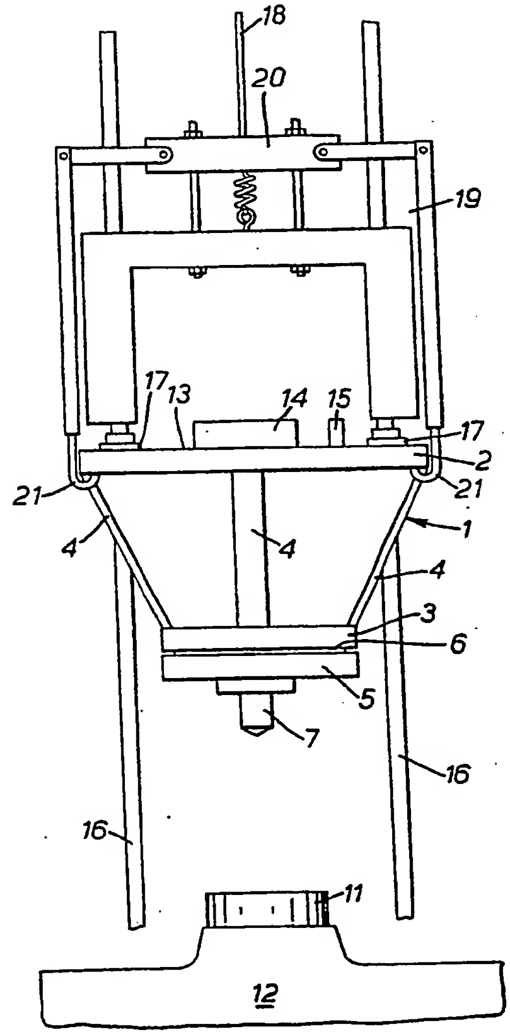
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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheets 1 & 2

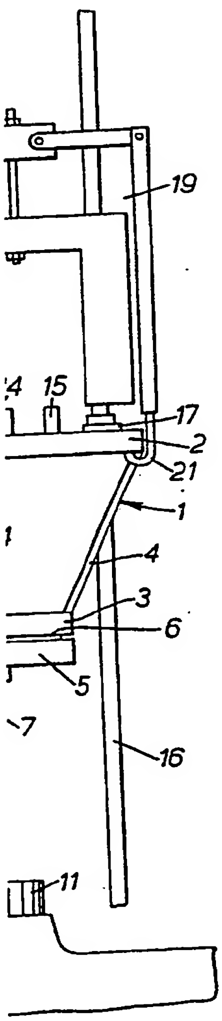


FIG. 1.

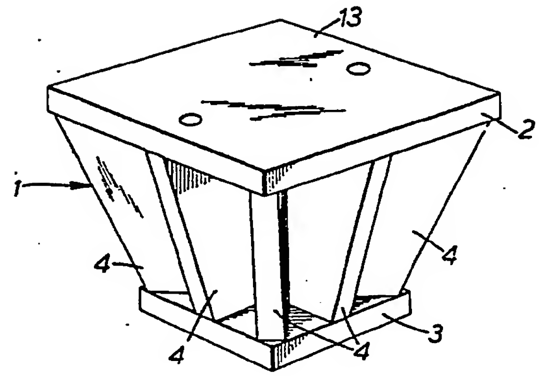


FIG. 2.

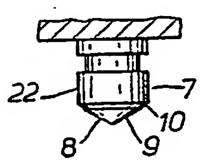


FIG. 3.

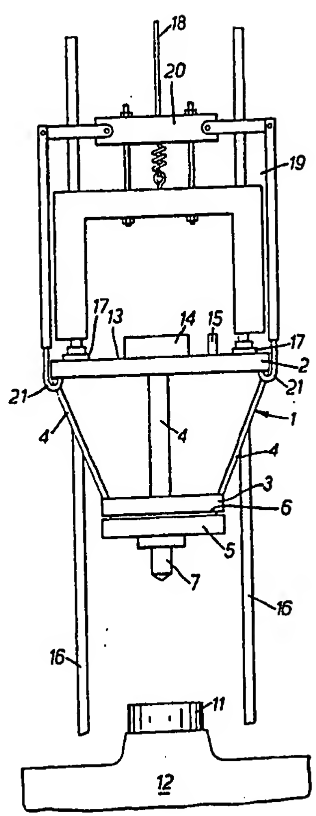


FIG. 1.

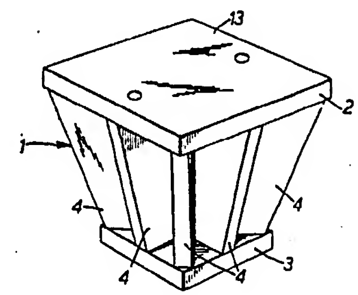


FIG. 2.

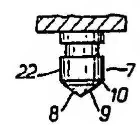


FIG. 3.